

TASK 2. DEVELOPMENT OF WQRRS MODEL FOR LAKE LODI

2.1 OBJECTIVE

The objective of this task was to develop a water temperature reservoir model for Lake Lodi using the WQRRS. The results of the WQRRS model for Lake Lodi provide input temperature for Module 3 of the SNTMP model developed for the Mokelumne River.

2.2 METHODS

2.2.1 Development of WQRRS Model for Lake Lodi

A 10 km long segment of the Mokelumne River, beginning approximately 24 km downstream of Camanche Dam, is dammed every summer to provide water for the WID Diversion Canal. About mid-April every year, the 50 m wide Woodbridge Dam, composed of flash boards, is installed in the Mokelumne River near Lodi to raise the level of the lake to fill the diversion canal. When the irrigation season is over in mid-October, the flash boards are removed to restore this section to a river reach. When Woodbridge Dam is present, Lake Lodi is a narrow, shallow, and long reservoir. Stratification occurs in Lake Lodi and, therefore, SNTMP is no longer valid for calculating water temperatures. BioSystems used WQRRS to model this segment of the river during the period when Lake Lodi is present. Using WQRRS for this segment provides a more accurate set of input data for the river below Woodbridge Dam.

2.2.2 Data File Preparation for WQRRS

WQRRS requires topographical, hydrological, meteorological, and water quality information (for Lake Lodi, water temperature) in its input data file. The Lake Lodi WQRRS model was calibrated using 1990 data, since this was the most complete temperature data set available.

EBMUD provided Lake Lodi topographic information describing the depth and volume relationship. USGS topographical maps (7.5 minute series) provided the length and elevation input data.

Measured inflow and water surface elevation data needed for the analysis of water transport through Lake Lodi do not exist. Thus, an equation using the discharge and distance relationship was used to estimate the inflow rates to Lake Lodi using the known flow rates of the three USGS gaging stations. The outflow rate used for Lake Lodi is the sum of flow rates for the gaging stations at WID Canal and below Woodbridge Dam.

Meteorological data are required for the heat budget algorithms in WQRRS to account for net heat gain or loss in the system because of weather conditions. Sacramento Airport data for air temperature, wind speed, dew point temperature, cloud cover, and air pressure were used in the model.

EBMUD's water temperature data from Lake Lodi were used as the input water temperature for the Lake Lodi model.

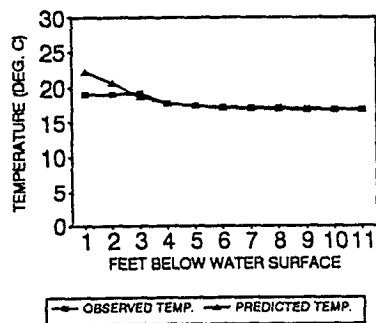
2.2.3 Calibration Method for WQRRS for Lake Lodi

The conventional WQRRS model calibration reduces the deviations between measured water balance and water quality (temperature) and their predicted values by adjusting various coefficients. Since there is no measured water balance data, the calibration of Lake Lodi involves only the predicted temperatures. To calibrate the WQRRS model for Lake Lodi, the various coefficients must be modified so that the model behaves like the real system. This is done by changing the Secchi disc depth (measure of light transparency with depth), water column minimum stability (density gradient above which mixing of the water column occurs), effective diffusion rate (internal transport of heat and mass in the vertical direction), and their associated coefficients that alter the behavior of the system.

2.3 CALIBRATION RESULTS FOR LAKE LODI MODULE

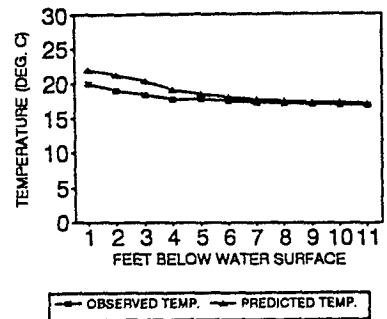
Since the Lake Lodi Module best represents the water profile temperature near the dam, the predicted water temperature to hydrolab reading taken in front of Woodbridge Dam were compared. Fifteen sets of water temperature profile data were available for the summer months in 1990. A comparison of these data sets showed that the mean difference in temperature profile for the fifteen sets was -0.43°C and the maximum single deviation was 2.43°C (see Figure 2-1).

4/26/90



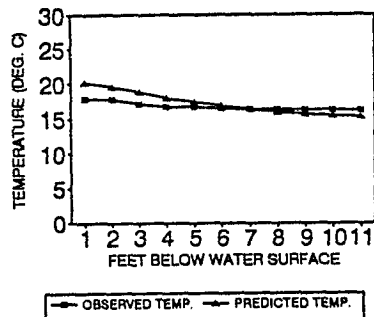
Mean diff = -0.33 C

5/3/90



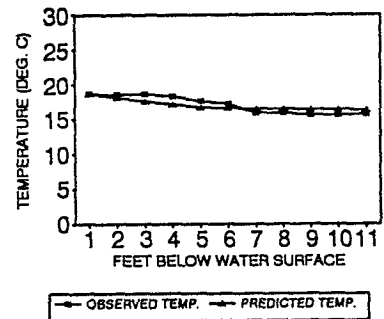
Mean diff = -0.94 C

5/24/90



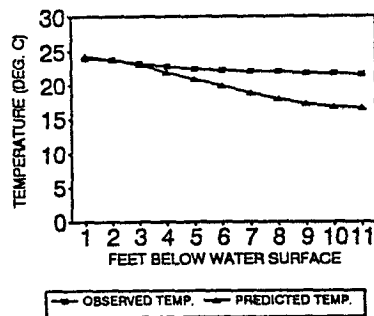
Mean diff = -0.52 C

5/31/90



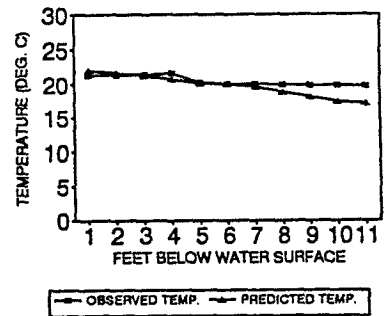
Mean diff = -0.07 C

6/8/90



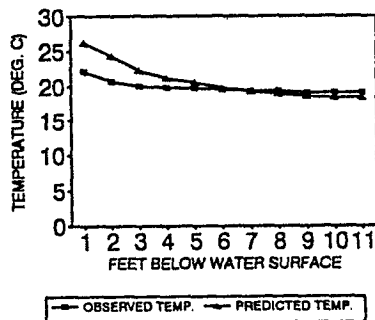
Mean diff = 2.43 C

6/13/90



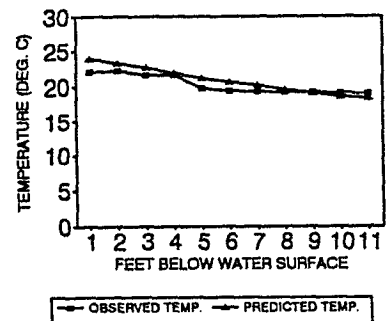
Mean diff = -0.79 C

6/19/90



Mean diff = -0.88

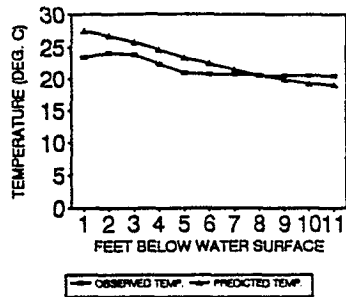
7/5/90



Mean diff = -0.62

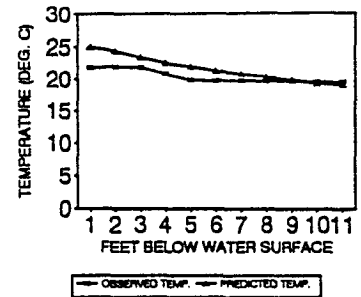
Figure 2-1. WQRRS calibration results for the Lake Lodi module (observed data are from in front of Woodbrige Dam).

7/19/90



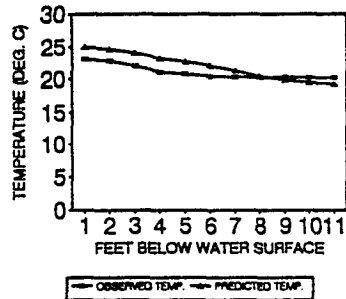
Mean diff = -1.07 C

7/26/90



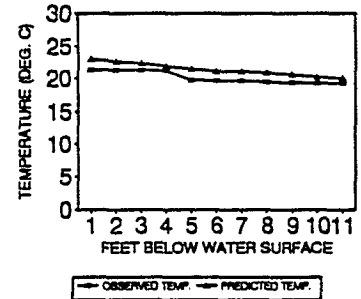
Mean diff = -1.25 C

8/2/90



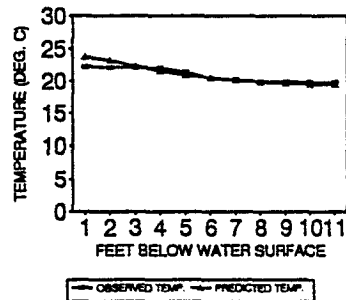
Mean diff = -0.92 C

8/16/90



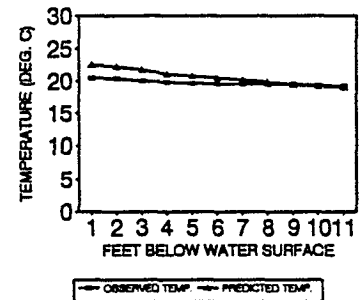
Mean diff = -1.24 C

8/30/90



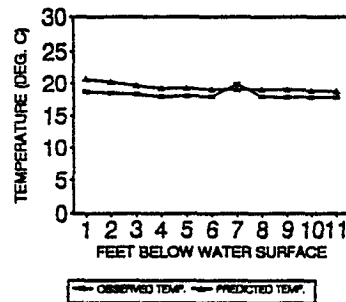
Mean diff = -0.07 C

9/19/90



Mean diff = -0.84 C

10/11/90



Mean diff = -1.12 C

MEAN DIFFERENCE FOR
ALL TEMPERATURE PROFILE = -0.43 C

MAXIMUM DIFFERENCE IN
TEMPERATURE PROFILE = 2.43 C

Figure 2-1. WQRRS calibration results for the Lake Lodi module (cont.).